CODAR CURRENTS NEWSLETTER
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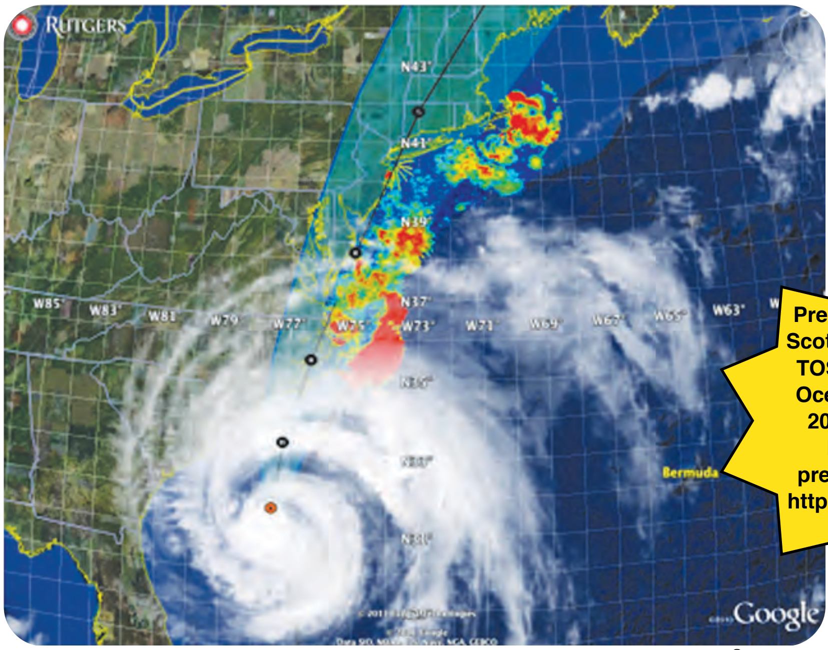
CODAR OCEAN SENSORS
THE LATEST IN HF RADAR TECHNOLOGY & APPLICATIONS
Spring 2012

# Improving Hurricane Intensity Forecasting Using Irene Case Study




Presented by Dr. Scott Glenn at the TOS/ASLO/AGU Ocean Sciences 2012 Meeting. Download presentation at: http://tinyurl.com/88m3vsu

Image shows hurricane Irene and its projected path along U.S. coast atop SeaSonde® surface current map. Provided courtesy of Rutgers University.

Hurricane Irene's visit to the U.S. east coast last August affected millions of people, breaking flood records in 26 rivers, was responsible for more than 37 deaths and causing nearly $8 billion in damages. During Irene's progression up the eastern seaboard grim forecasts were made of how the storm would evolve and impact the nation's most populous region, the mid-Atlantic bight. This was the first tropical storm to threaten New York City since 1985 and while scientists accurately predicted its track, its intensity was consistently over predicted, setting off a media panic, with speculation that Irene might retain hurricane status as it approached New York's low-lying Manhattan.

**SeaSonde, Glider & Satellite Data Improve Understanding of the Forecast Deficiency**

A team of scientists led by Dr. Scott Glenn of Rutgers University performed a hindcasting exercise to better understand why the forecasts were overestimating intensity. Their exercise used data collected by the Mid Atlantic Regional Association Coastal Ocean Observing System (MARACOOS) during the event, including surface current maps from a suite of SeaSondes, satellite-derived surface temperatures, and critical sub-surface temperature data gathered by two gliders. With this field data applied, hindcasting results showed forecasts had not adequately factored in the effect of the highly stratified vertical thermocline. Vertical mixing caused by the hurricane winds resulted in a rapid and significant drop in surface temperatures that quickly weakened the hurricane into a storm.

## INSIDE THIS ISSUE

# Outcome of the 2012 World Radiocommunication Conference:

# Oceanographic HF Radars Officially Recognized by ITU

The International Telecommunication Union (ITU) is the United Nations special agency for information and communication technologies responsible for the worldwide management of the radio-frequency spectrum and "development of technical standards that ensure networks and technologies seamlessly interconnect". The ITU convenes every 4 to 5 years in a World Radiocommunication Conference (WRC) to make decisions resulting in treaties regulating global standards.

Of importance to our user community throughout the world is Resolution 612: Use of the radiolocation service between 3 and 50 Mhz to support (high-frequency) oceanographic radar operations.

**Resolution 612 Outcome**
The outcome of this resolution is that for the first time "oceanographic radars" are officially recognized by ITU, with their own primary, provisional primary, and secondary bands.

**Benefits to HF Users**
Once in effect, this resolution will benefit the oceanographic HF community, as it is expected that:
• the licensing process (approvals for radio transmission) by government agencies will proceed smoother and will be concluded faster;
• users will be able to plan with certainty at which frequency their network can operate.

Complete ITU 2012 WRC Agenda and References document can be viewed at:
http://www.itu.int/dms_pub/itu-r/oth/0C/04/R0C0400000700001PDFE.pdf

**Bottom Line**
**CODAR will produce, sell, and support SeaSondes that operate in all of the ITU allocated bands and conform to any local regulations**.

**What Existing HF Users Need to Do Now**
No immediate action is necessary by any HF radar operator until the service rules and licensing regulations are developed and promulgated.
**Developing Service Rules & Licensing Regulations**
While the ITU sets global standards, each Region and country within will set specific service rules and licensing regulations, so there will be some variations among countries. In the United States (which is part of Region 2), development is the responsibility of NTIA and FCC. We expect this to be a lengthy process, spanning months, with some aspects taking even two years to complete. Similar timelines might apply to rules and licensing regulation development for other regions and countries.

**What Will Happen to Existing Experimental Licenses (that presently operate under WRC Section 4.4)**
Already approved operations as "experimental" licenses in other bands (outside of the new WRC-allocated bands listed below) will not automatically go away. Individual country authorities will need to determine how and when this might happen, if it happens at all. Presumably once the implementation of the WRC decision is complete, at least some oceanographic radars will need to begin transitioning to the new allocated bands, operating under the new service rules, when their experimental licenses reach expiry date and require new or renewal licensing. Use of the new bands should not begin until the service rules are in place and a new license has been issued to an oceanographic radar operator. In most cases, transitioning SeaSondes to the nearest allocated band should not require major hardware modification.

## The Details

### Primary Allocations

The WRC provided primary and secondary allocations for oceanographic radar worldwide. However, there is a footnote in the documents that essentially means that oceanographic radars can be shut down if interfering with another existing or future system that requires a primary license at that frequency.

**The WRC-Allocated Bands and Total Spectral Widths Are:**

4.438 - 4.488 MHz 50 kHz (approved as secondary band in Regions 1 & 3, and provisional primary in Region 2)
5.250 - 5.275 MHz 25 kHz (approved as secondary band in Regions 1 & 3, and provisional primary in Region 2)
9.305 - 9.355 MHz 50 kHz (approved as secondary in Regions 1 & 3, not approved for Region 2)
13.450 - 13.550 MHz 100 kHz (approved as a secondary band for all regions)
16.100 - 16.200 MHz 100 kHz (approved as secondary band in Regions 1 & 3, and provisional primary in Region 2)
24.450 - 24.600 MHz 150 kHz (approved as provisional primary in Region 2)
24.450 - 24.650 MHz 200 kHz (approved as secondary for Regions 1 & 3)
26.200 - 26.350 MHz 150 kHz (approved as secondary for Regions 1 & 3)
26.200 - 26.420 MHz 220 kHz (approved as provisional primary for Region 2)
39.0 - 39.5 MHz 500 kHz (approved as secondary for Region 1)
39.5 - 40.0 MHz 500 kHz (approved as primary for Region 3)
41.015 - 41.665 MHz 650 kHz (approved as provisional primary for U.S. and Rep. of Korea)
43.350 - 44.000 MHz 650 kHz (approved as provisional primary for U.S. and Rep. of Korea)

### Converting Your Existing SeaSonde Network to a Primary Band

If you are requested by local radio authority to change frequency of operation to one of the WRC-allocated primary bands, then CODAR and its regional technical partners will work with you to convert your SeaSonde network. In some cases the change can be done simply with a software setting adjustment, while in other cases a hardware adjustment at the site and a re-tuning of antennas and filters may be required. No reconfiguration of SeaSonde antenna layout will be needed.

### Interpreting "Total Spectral Width" Listed in Table

Some of these slots will likely be broken into sub-bands when licenses are issued, however this detail will be decided by individual countries' approval authorities. It is prudent for for all radar operators below 10 MHz to expect and plan on use of only 25 kHz bandwidth or less. For example, the 50-kHz slot between 4.438 - 4.488 will likely become two 25-kHz channels side by side. For those 100 kHz slots 13.450 - 13.550 & 16.100 - 16.200 we expect that these will each be divided into two 50-kHz channels side by side.

**Bandwidth - Range Resolution Relation before Range Software Windowing***

| | |
|---|---|
| 25 kHz bandwidth | => a ~6-km range cell |
| 50 kHz bandwidth | => a ~3-km range cell |
| 150 kHz bandwidth | => a ~1-km range cell |

*SeaSonde software processing window extends range cell by 17%; windows required by others extend cell to 100%

It is speculated that the countries inside any Region will attempt to have uniformity on this band/sub-band issue, since a country that grants sweeping across a 50 kHz bandwidth and a neighboring country authorizing use of a 25 kHz bandwidth will interfere with each other, making effective operation for both impossible.

### Transmit Identifier or Call Sign

Each radar will have to transmit a call sign, in Morse code, at least once every 20 minutes. The exact method for doing this will be decided at WRC Working Party meetings over the course of the next year or two. Once specific requirements are set, then CODAR engineers will begin developing a technique that can be implemented locally on each SeaSonde, with either software or firmware change that someone local can do with our help, to minimize costs.

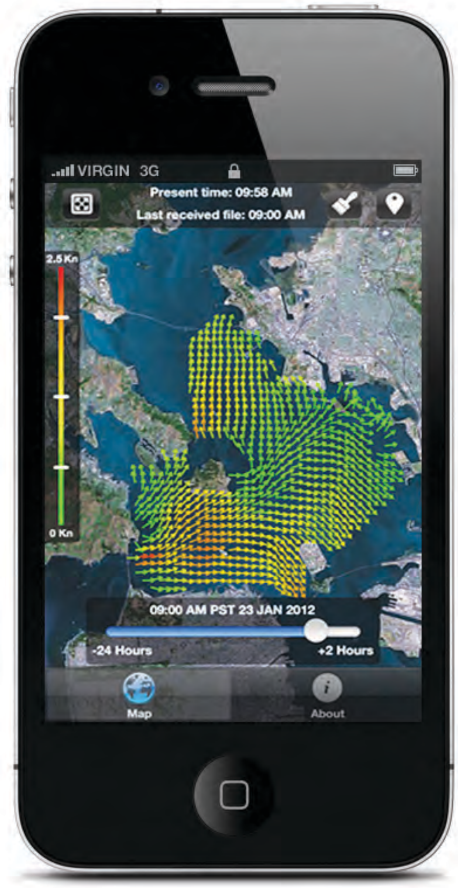
### Minimizing Mutual Inter-Radar Interference Potential

Each radar will have to minimize interference potential. Exact wording is "should, where applicable, use techniques that allow multiples of such radars to operate on the same frequency, reducing to a minimum the spectral occupancy of a regional or global deployment of radars." Radars within the same and adjacent countries/regions will clearly need to operate simultaneously on the same frequency while avoiding mutual interference. Lower-frequency CODAR SeaSondes are already delivered with the SHARE technology (GPS-enabled modulation multiplexing) that provides this capability, and is an easy add-on for any SeaSondes not already possessing SHARE feature.

No other changes to hardware or existing systems are anticipated. Contact CODAR if you have further questions or concerns.

***News Release issued by San Francisco State University Communications Office***

# Currents on the Bay: There's an App for That!




Jan. 23, 2012 -- A new iPhone and iPad application designed by researchers at SF State provides real-time and predicted information on surface currents within the San Francisco Bay.

The app, called "Bay Currents", relies on data supplied by the Coastal Ocean Currents Monitoring Program in Northern California (COCMP-NC), which monitors offshore currents and reports that information to the public. SF State is responsible for monitoring currents in the San Francisco Bay and along the coast from south of Point Reyes to Pillar Point near Half Moon Bay.


SF State monitors land-based sensors along the coast and San Francisco Bay that emit radio waves and measure the Doppler shift of the return frequency to determine the direction of currents. By using information from multiple sensors, researchers get an accurate picture of real-time coastal currents. The COCMP-NC then posts the updated information to its website every half hour.

The app uses Google Maps and GPS to give sailors a real-time look at currents in the Bay, the previous 24 hours of currents and a projection for the next two hours.

"A sailor wants to know what is going on around him. And San Francisco Bay is interesting because the currents are so strong, probably the strongest currents on the California Coast," said Professor of Geosciences Newell 'Toby' Garfield, who developed the app along with the Project's Operations Manager Jim Pettigrew. "So if you're out as a sailor, both from a safety point of view, as well as being able to plot a route to your destination, it's good to know what the currents are."

Users can locate their current location on the water using the GPS technology or place pins at points in the Bay to get an understanding of the currents at that location. The easily accessible information will help crews competing in the yacht races on the Bay.

The app, which was funded by the California Coastal Conservancy and the National Oceanic and Atmospheric Administration's Integrated Ocean Observing Systems Office, is available for free through the Apple App Store.

*This news release issued by San Francisco State University Communications Office was originally published at http://www.sfsu.edu/~news/2012/spring/10.html*

***CODAR clarification for readers: the "land-based sensors along the coast and San Francisco Bay" referred to in this article are SeaSondes!***

# SeaSonde Radial Suite Release 7 Software Package Now Available

Every SeaSonde user from beginner to advanced will find something new and exciting in Radial Suite Release7 (R7). SeaDisplay has been rewritten from the ground up to be simpler to use but with more features for viewing and analyzing multiple data sets simultaneously. In addition, R7 features new "stripe" noise suppression, 1st order boundary-defining parameters that operate on on a per range cell or range cell set basis, a greatly expanded archiving application and more advanced controls in the RadialSetup application, among others. For the advanced user, the new radial metric output is now available as part of the standard installation. With a single setting you can now output all of the MUSIC and signal-to-noise values for every Doppler value found in the Bragg peaks in our standard MATLAB-compatible format, making low-level analysis of your data easier than ever. These are but a few of the new features available in R7. For a complete list of new features and minimum software and hardware requirements, please visit the company web site www.codar.com. R7 software will require a special USB license key be connected locally to the computer. For information on purchasing R7 and obtaining a software key, please contact your local authorized CODAR representative or CODAR headquarters (support@codar.com).

# SeaSonde Signals Used for Coronal Mass Ejection Studies

A Coronal Mass Ejection (CME) is a burst of charged particles from the upper atmosphere of the Sun that can disrupt radio transmissions, cause damage to satellites and electrical power grids and produce incredibly beautiful aurorae as seen at right.

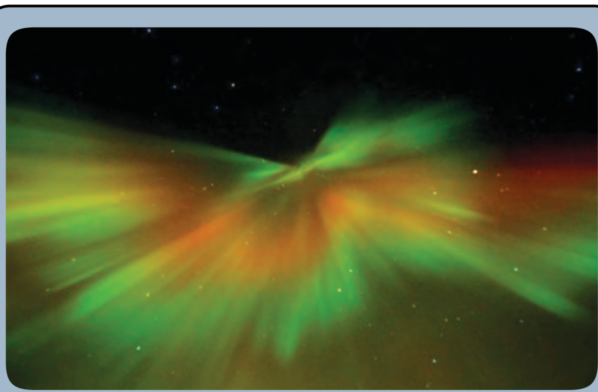


Image credit ~ Jason Ahrns

SeaSonde transmit signals were recently used to look at the effect on the Earth's ionosphere from the January 22 CME. What was interesting about this study, though, was that it was not done in a research lab with specialized SeaSondes and expensive scientific equipment. The SeaSondes that provided the transmit signals were the same ones that monitor the United States coastal oceans for US IOOS Program and the receive equipment was a commercially available software defined radio (SDR) manufactured by RFSpace Corp. of Atlanta, GA. Radio engineer and president of RFSpace Corp., Pieter Ibelings, was able to "listen" to SeaSonde signals from all over the U.S. and empirically determine the waveform parameters. Using this and the station information published on the Scripps Institute National HF Radar page, Mr. Ibelings was able to map the heights of ionosphere layers over time as shown in the figure at left.

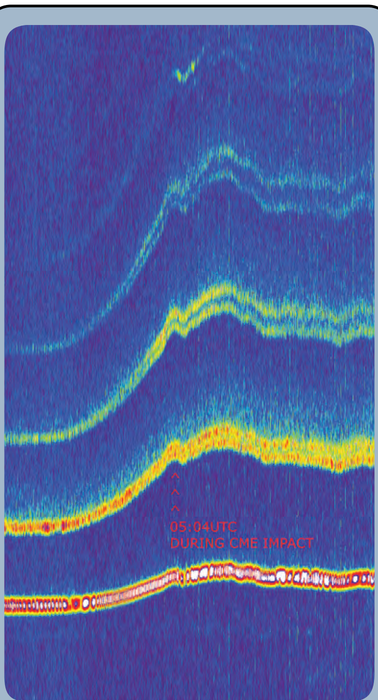



Image credit ~ Pieter

As long range HF radar users and amateur radio listeners are aware, signals in the lower part of the HF band can propagate over very long distances by bouncing off the ionosphere and Earth surface. The FMCW chirp that the SeaSonde uses allows it to be easily identified and synced. According to Mr. Ibelings, "The signals are almost perfect for ionospheric sounding since they are linear chirps. I capture the chirp with a receiver locked to GPS both in frequency and time. I then de-chirp the waveform so I can extract the time of arrival information at my location." However, in order to most effectively use the signals around the U.S. that are operating on the same frequency, knowledge of each station's GPS timing alignment values is needed.

For more information on Mr. Ibelings' ionospheric studies using SeaSonde signals & SDRs, please visit www.rfspace.com and click on "BLOG".

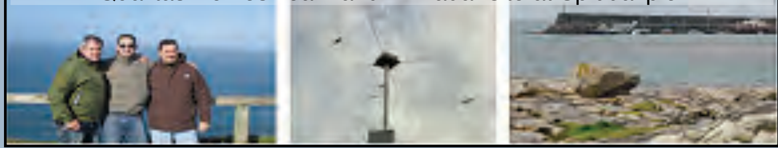
# Welcome NUI Galway to the CODAR Community

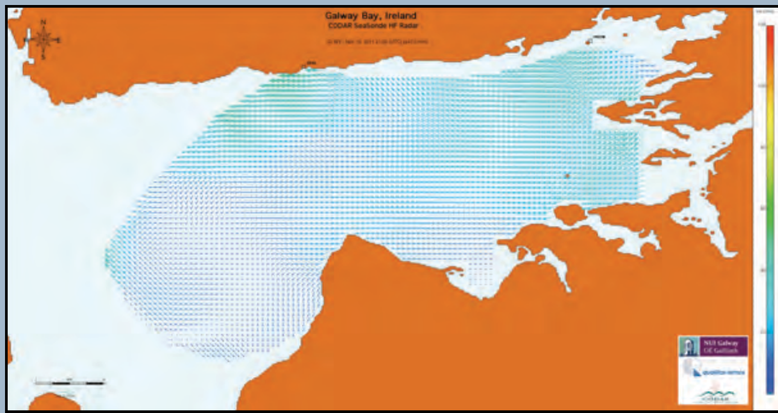
NUI GALWAY recently completed the installation of the first HF radars in Ireland, a SeaSonde network delivered and commissioned by the engineering company QUALITAS that is now providing continuous high quality real-time 2D currents vector maps and wave parameters.

The two radar units were installed in the Mutton Island Waste Water Treatment Plant and on top of the Spiddal pier with all the data being transferred by means of a WIMAX wireless system to the central data management platform at the new NUI Galway engineering building.

NUI Galway main research interest with the SeaSonde HF Radar deployment inside the SmartBay Project includes high resolution circulation modeling, water quality modeling, data assimilation and numerical and scale modeling.

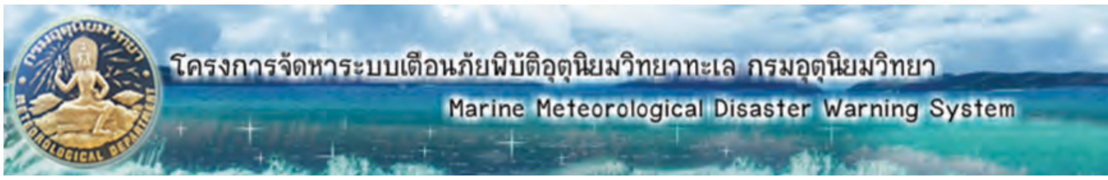
Qualitas Remos Team and HF radar site at Spiddal pier






2-D surface current map produced by SeaSonde network in Galway Bay

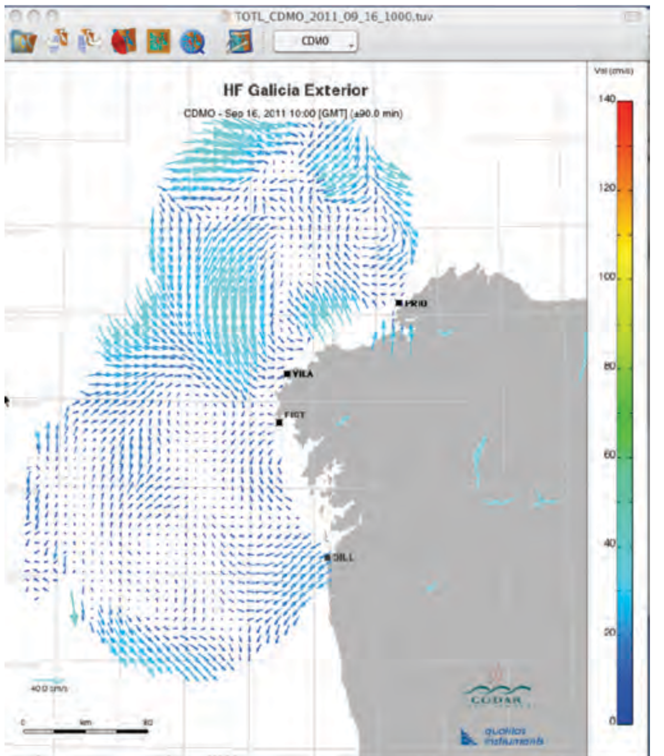
# SeaSondes Added to Thai Marine Disaster Warning System




Three SeaSonde networks are providing valuable current information to Thai disaster management authorities, operated by local company MetLink Info Co., on behalf of the Thai Meteorological Department. The SeaSonde-derived current and wave data from these networks is now available to the public via the Internet at: http://www.oceansky.tmd.go.th

# SeaSonde Network Expansion Along Spain's Galicia Coast

Two more Long-Range SeaSondes were recently installed at Vilano and Prior, nearly doubling the network coastal coverage along Spain's Galicia coast. Expanded coverage is shown at right.



# Recommended Reading


Barrick, D., V. Fernandez, M. I. Ferrer, C. Whelan, and Ø Breivik. "A Short-term Predictive System for Surface Currents from a Rapidly Deployed Coastal HF Radar Network." *Ocean Dynamics - special issue: Advances in Search and Rescue at Sea,* (2012).

Kjelaas, A. G., and C. Whelan. "Rapidly Deployable SeaSonde For Modeling Oil Spill Response." *Sea Technology, 10-15* (2011).

Long, R. M., D. Barrick, J. L. Largier, and N. Garfield. "Wave Observations from Central California: SeaSonde Systems and In Situ Wave Buoys." *Journal of Sensors,* Vol. 2011, 1-18(2011).

Zhao, J., X. Chen, W. Hu, J. Chen, and M. Guo. "Dynamics of Surface Currents over Qingdao Coastal Waters in August 2008." *Journal of Geophysical Research*, Vol. 16, 1-15 (2011).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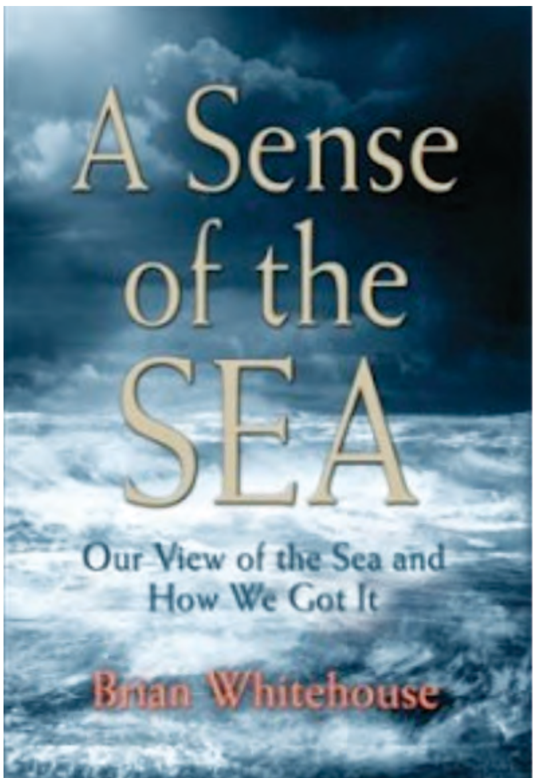
The newly released book **A Sense of the Sea: Our View of the Sea and How We Got It**, is a compilation of unique factoids and insights that anyone working in the ocean sector should find interesting. Its author Brian Whitehouse holds a PhD in Oceanography from Dalhousie University and has decades of learned and applied expertise in the field of remote sensing, both spaceborne and coastal HF radars. He is President of OEA Technologies Inc.



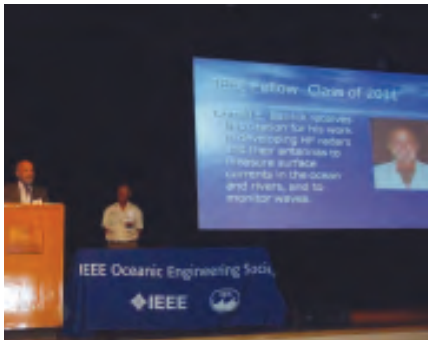

"We all have a sense of the sea around us, but we can sense something without understanding it. Most of what we know about the sea is a result of navy-backed programs conducted during World War II and the Cold War that followed. Although they changed our understanding of the sea, their results remain largely unknown to the public-at-large. As a result, most people grew up with a perception of the sea, but little knowledge of it." Brian G. Whitehouse


Author Dr. Brian Whitehouse

If you are interested in seeing a photo of Junior, the taxi driver associated with the CODAR related story in the book, visit the book's Facebook page, which also includes a photo of a CODAR antenna. The url is http://facebook.com/SenseTheSea Books can be purchased at http://amazon.com/author/whitehouse

# Congratulations Donald Barrick, IEEE Life Fellow

CODAR company president Dr. Donald Barrick was awarded the IEEE Life Fellow of the Oceanic Engineering Society, for development of high frequency radars and applications. This is the highest grade of membership in IEEE. Dr. Barrick, accompanied by his wife Pat (image below), accepted the award at the MTS/IEEE Oceans '11 in Kona, Hawaii this past September.





# See Us At These Upcoming Events

**Oceanology International 2012**
13-15 March 2012 in London, England,
http://www.oceanologyinternational.com/

**ROW-2012**
17-19 April 2012 in Toulon, France,
http://web.me.com/paduan/row/ROW_Home.html
**With a special CODAR Technical Seminar to occur on 20 May immediately following ROW-2012.**

**1st Ocean Radar Conference for Asia (ORCA)**
17-18 May 2012, Seoul, Korea
http://korf.kunsan.ac.kr/xe/index.php?mid=ORCA_ann

**Oceans 2012**
21-24 May 2012 in Yeosu, Korea
event web link: http://www.oceans12mtsieeeyeosu.org/


CODAR Europe manager Andres Alonso-Martirena and international business specialist Jorge Sanchez at the Offshore Arabia conference held in Dubai February 2012.